Eddy Current Defectoscopy with Utilisation of Cross-Correlation

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Abstract **The mathematical model of surface defect detection using a reflection differential eddy current probe is described. The model was solved using finite element method (FEM). Cross-correlation of the obtained signal with a reference pulse was used for evaluation of the defects.**

Keywords **Defectoscopy, cross-correlation, eddy currents, testing.**

I. Introduction

Considered probe consists of an excitation coil wound around two pick-up coils with ferrite cores. Eddy currents are excited by short trapezoidal pulses. In the case of centered homogeneous body under the probe the induced voltages in both pick-up coils are identical. Inhomogenity in shape, conductivity or permeability of the body under probe leads to different induced voltage and the defect can be detected.

II. Mathematical model

In Fig. 1 is shown the arrangement of the model. The transient problem is considered as planar and solved in 2D arrangement. Pick-up coils are not regarded, because magnetic flux density in their cores is evaluated instead of the induced voltage. In this approach the materials are considered as linear. We used our own codes Agros2D and Hermes.

The problem in time-dependent magnetic field was solved repeatedly with different position of defect on the surface of metal sheet. An additional computation was performed with metal sheet starting under the center of the probe, ergo only under one of the cores. This computation was used as reference defect.

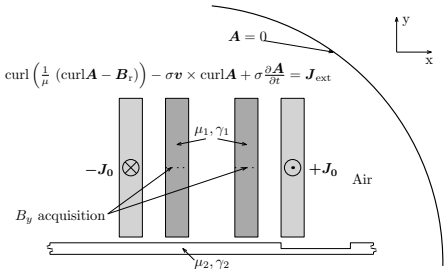

Fig. 1. Problem definition

III. Evaluation of solution

In the center horizontal plane of the cores are acquired several values of magnetic flux density and these values are averaged for each of both cores. Concatenation of obtained waveforms simulates measuring signal. Difference of signals from the cores can be seen in Fig. 2 above. Below is a piecewice cross-correlation of this signal with the reference computation. More interesting is evaluation

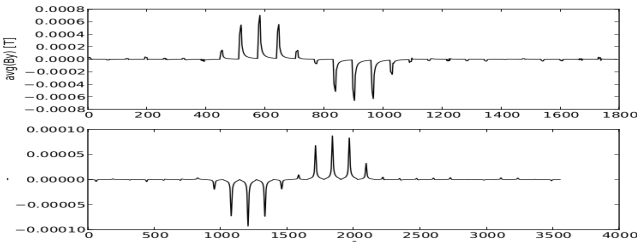

Fig. 2. Difference of signals; Cross-correlation with reference pulse

of signal with added noise. See Fig. 3, even in very noisy signal can be position of defect detected.

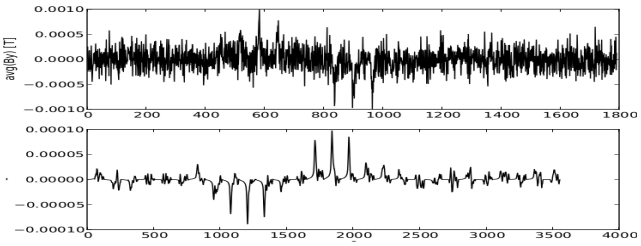

Fig. 3. Results with added noise

IV. Conclusion

The using of cross-correlation in conjunction with reflection diferential eddy current probe appears to be promising for detecting surface cracks. In future work will be investigated different shapes of probe and different kinds of defect.

V. Acknowledgements

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